The concept of flavor styles to classify flavors

Summary

Flavor is an intriguing theme which can be studied from many different angles. Taste, flavor, and related concepts are poorly defined which leads to the situation that in literature the same words are used for different concepts. In the first chapter the concepts are defined. It alone helps to reduce the complexity of the subject.

This thesis deals with the scientific validation of a proposed new system to classify flavor. Flavor can be classified based on the parameters mouthfeel and flavor richness. These parameters were discovered based on experience in daily practice and led to the depiction of the Flavor Styles Cube which is introduced to represent a systematic description of flavor. It is first based upon the distinction in two main characteristics of mouthfeel, coating and contracting. These are two dimensions of flavor, flavor richness is the third. Any of these dimensions can be classified from low to high, which gives eight possible combinations: the flavor styles. These can be considered as sub-cubes of the Flavor Styles Cube; products that are close to the corners of the cube can be considered as the 'icons' of flavor. It is important to note that these dimensions are defined at a level of abstraction that goes beyond the molecular properties of products or the human registration of these substances. For instance, there are many sources of contraction with very different origins, all of which have a similar effect on mouthfeel. Chapter 1, introduction, explains the empirical model and the aspects that are involved.

Support for this classification of flavor is found in the first place in the human physiology of flavor registration. Clearly, if humans were not equipped to register mouthfeel and/or flavor richness, it would be difficult to accept that these parameters can be used to classify flavor. An extensive review of the literature about the physiology of taste and flavor registration (chapter 2) revealed that flavor registration (tasting) relies on a simultaneous activity of three neural systems, the gustatory, olfactory and trigeminal system. Flavor information is gathered through these systems and communicated to the brain where it is assembled. With the current state of knowledge about the functioning of these systems it seems difficult to pinpoint exactly which system registers what; cross modal interactions impede interpretation. However, generally speaking, the gustatory and olfactory systems are likely to contribute to flavor richness, while the trigeminal system is mainly involved in the registration of mouthfeel. This system relies on three different kinds of receptors which lead to three main groups that influence mouthfeel: thermal (i.e. temperature of foods and drinks), pain (i.e. capsaicin and other irritant substances), and mechanical (textural elements like hard, soft, creamy and crispy).

Secondly, a consumer survey was executed to evaluate the practical model and to see if the supposed structure of the flavor styles cube could be found (chapter 3). Support was found using factor analysis and statistical procrustes analysis. The practical model was

evaluated by choosing flavor characteristics (attributes) that could describe corners of the flavor styles cube. Well-known food products with a stable and brand-independent flavor profile, were selected and consumers were asked in a questionnaire to rate these products on the chosen attributes. The eight corners of the flavor styles cube could be identified, and when forced into three factors, the supposed three-dimensional structure emerged. These analyses confirmed the three factors coating, contracting, and flavor richness. The variance explained was 70,7%, the least square method gave 0,65, and the tucker coefficients were 0,76 (coating), 0,75 (contracting), and 0,91 (flavor richness). These are highly significant values for this kind of research, which adds to the scientific validity of the model. In further analysis products were positioned in the flavor styles cube and compared to their a-priori supposed position. 68,75% of the products were classified as expected.

Further support was found when the flavor styles cube was used to classify wines (chapters 5 and 6). One of the flavor styles, around corner 6 of the flavor styles cube, represents wines that are coating with high flavor richness. Such wines get their coating character from sweetness and are classified as 'full'. Yet wines can be rich in flavor, score high in coating elements, *while* being dry (no sweetness). If such wines are also high in contracting elements (acidity), they would fit in corner 7. In other food products than wine this flavor style is often characterized by proteins. Evidently, wines have no proteins. Therefore it was hypothesized that they would be rich in amino acids, and particularly rich in glutamic acid (GLU) which is known to be an important enhancer of flavor in many other products. The general term used for this kind of flavor richness is 'umami'. To verify the link between corner 7 and GLU, ten wines were selected which were supposed to represent different profiles of amino acids, and in particular the level of GLU. Chemical analysis confirmed the presence of GLU as expected. Regression analysis showed a strong relation between wines with high amounts of GLU and flavor richness. When manually added to wines, these wines were also regarded as being richer in flavor. As mouthfeel is balanced at a high level, the classification of these wines in corner 7 is correct.

Next to these explicit results in support of the concept that flavor can be classified, leading to flavor styles grouped in the flavor styles cube, there is an implicit line of reasoning. It concerns the use of flavor styles. The proposed classification of flavor is based on the multi-sensory experience, and offers a level of abstraction that goes beyond products or their principal components, like sweetness, saltiness, bitterness, acidity, fattiness, etc. Classification systems should give a better understanding of complex subjects by making it possible to treat non-identical components as equivalent. This implies that if the proposed classification of flavor should do just that, this can be considered as 'supportive evidence'. This is one of the results of chapter 4. It describes the result of studies that deal with the subject of palatability. This is defined as the successful combination of product characteristics, which are liked by the consumer. To assess the concept of palatability a study was executed in which

prominent chefs were asked to describe their most successful dishes. Comparison of these dishes was possible by making use of the level of abstraction of the proposed classification of flavor. Without prior training the chefs were able to use the terms 'contracting', 'coating', and 'flavor richness', and it was possible to formulate six Culinary Success Factors (CSFs) that determine palatability. These results were confirmed in a study where CSF dishes were evaluated by a tasting panel. Three sets of dishes were created. One of the three complied with all CSFs, the other two were slightly modified. In each of the three sets of dishes the CSF dish was preferred and found to be more palatable than the other two. These results shed an interesting light on palatability and could be achieved by making use of the parameters of the flavor styles cube.

In chapter 7 these results are discussed in a wider perspective. In this chapter examples are mentioned of studies on flavor of specific products that also support the view that mouthfeel and flavor richness are important aspects. In flavor intrinsic and extrinsic components can be distinguished. The intrinsic components are 'tasted'; the extrinsic components influence food choice and ultimately flavor itself. Flavor styles may help consumers to make 'better' choices, especially in the case of food products where reliable sensory information is limited or not available. Flavor styles communicate to the consumer what kind of flavor can be expected. The theorem of flavor styles is therefore formulated as 'the function of flavor styles increases as the amount of reliable sensory information decreases'. Liking a certain flavor is closely related to making the 'right' choice, which in turn implies that 'expectation' is strongly related to liking. The proposed classification of flavor can serve a purpose in that respect to food professionals. The 'behavioral process of food choice' is presented as a model of food selection.

A principal question is whether there is sufficient evidence presented to accept the described concept of flavor styles, as is introduced in the introduction. The dimensions 'contracting', 'coating', and 'flavor richness' were formulated in daily practice where they proved to be very useful in getting a better understanding of flavor and flavor reactions, for instance wines and foods. This thesis is a next step in trying to find a scientific base for this supposition. Strong indications were found in support of the acceptance of the concept of flavor styles to classify flavors. Further research is encouraged.